THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. III. APRIL 15, 1875. No. LIII.

CONTENTS.

	PAGE
Contact *v.* Chemism	85
ARTICLES:—	
Special Telegraphy	86
A New Direct Measurement Galvanometer, by J. T. Sprague	86
Harrison Gray Dyar	87
The Voltaic Battery; a Course of Six Lectures by Dr. John Hall Gladstone, F.R.S., delivered at the Royal Institution of Great Britain. Lecture IV.—The History of the Battery in its Various Forms	88
NOTES	93
CORRESPONDENCE:—	
Electrical Puzzles	94
Inquiry	95
ELECTRICAL SCIENCE IN ENGLISH AND FOREIGN JOURNALS.—Experiments on the Artificial Imitation of Magneto-polar Native Platinum—On Magnetism	95
Lymington Literary Institution	96
Post-Office Telegraphs	96
OUR EXCHANGE	96
TO CORRESPONDENTS	96

TELEGRAPH WIRE.

Steel and Iron, English and Foreign make.

M. SELIG, JUNIOR, & CO.,
108, QUEEN VICTORIA STREET, LONDON, E.C.

BLOCK TELEGRAPHS.—TYER and Co. (late Tyer and Norman), Mechanical and Electrical Telegraph Engineers and Contractors, beg to inform Railway Managers, Engineers, Telegraph Superintendents, and others that, in consequence of the increasing demand for the Self-magnetising Block Instruments, they have secured New and more Commodious Premises, situated No. 4, Old Street, Finsbury (two minutes' rom Aldersgate Street Station), where they are now prepared to supply their Improved apparatus upon short notice.—Offices and Works, No. 4, Old Street, Goswell Road, Finsbury.

Telegraph Engineer and Contractor.—ARTHUR H. W. RADCLIFFE, 7, Union Street, Birmingham.—Private Lines of Telegraph Erected; Merchants Supplied with Instruments, Batteries, Tools, and Stores of every Description

PATENTS. PATENTS.

ROBERTSON, BROOMAN, and Co. (established 50 years) continue to obtain Patents for Inventions. Pamphlet, containing special advice, gratis or by post.—166, Fleet Street, London.

TO INVENTORS.

MESSRS. BREWER and JENSEN, British, Foreign, and Colonial Patent Agents, give prompt personal attention to all matters entrusted to them.—Office for Patents, 89, Chancery Lane, W.C. Established 1844.

The MODEL ELECTRIC TELEGRAPH (Strongly recommended.)—Single Needle Instrument, with alphabet on dial, polished mahogany stand, continuous battery, keys, connecting wires, line wire, and instructions, packed in box complete, post free, 36 stamps. "A real working model, well got up."—*English Mechanic.*—J. Theobald and Co., 20, Church Street, Kensington, London, W.

Send for M. Volk's Catalogue of Telegraph Instruments, Batteries, Induction and Medical Coils, Electric Bells, Indicators, Clocks, Gas Balloons, Telescopes, Microscopes, Opera Glasses, Barometers, Thermometers, Hydrometers, Mathematical Instruments, Spectacles, &c., &c. The Patent Gas Engine, ¼ to 2 horse-power. Two stamps, novelty list included.—Telegraph Works, Brighton.

H. M. CAPNER, Manufacturer of Electrical-Galvanic, and Philosophical Apparatus of every Description.—20, Northampton Square, Clerkenwell, E.C,

LATEST EDITION OF CULLEY'S TELEGRAPHY.

Just published in 1 vol. 8vo., with 144 Woodcuts and 5 Plates of Machinery and Apparatus, price 16s. cloth,

A HANDBOOK OF PRACTICAL TELEGRAPHY. By R. S. CULLEY, Member Inst. C.E. Engineer-in-Chief of Telegraphs to the Post Office. (Adopted by the Post Office and by the Department of Telegraphs for India.) A New Edition, being the Sixth, thoroughly revised and enlarged

London: LONGMANS, GREEN, and CO., Paternoster Row.

Just published, in crown 8vo., price 8s.

ELECTRICITY. ITS THEORY, SOURCES, AND APPLICATIONS. By JOHN T. SPRAGUE, Author of Electro-Deposition of Metals. With 91 Woodcuts and 30 Valuable Tables.

London: E. and F. N. SPON, 48, Charing Cross.

Protected by Her Majesty's Royal Letters Patent.

GENT & CO.'S NEW SYSTEM OF HOUSE BELLS.

Possessing all the advantages of Electric and Pneumatic Bells without any of their defects, at one-third less cost, and can be fixed by any workman without previous knowledge.

Agents Wanted in Unrepresented Towns.

JOHN T. GENT & CO., Friar Lane, Leicester.

NOTICE.—Messrs. O. and F. H. VARLEY, Telegraph Engineers and Contractors, Manufacturers of Large Induction Coils and all Electrical Apparatus, request all communications to be addressed to the Works during the Re-Building of 11, Poultry, for City Improvements.—Mildmay Park Works, Mildmay Avenue, Stoke Newington N.

ROYAL POLYTECHNIC.—ON EASTER MONDAY. New Programme.—1. New Lecture by Prof. GARDNER on COOKS and COOKERY.—2. New Lecture by Mr. KING, on SPAIN.—3. The ISLE OF WIGHT, with new Views.—4. New and original Optical, Magical, and Musical Entertainment, THE MAGICIAN AND THE GENII, in which several wonderful illusions and mysteries will be shown. The Entertainment has been written by Dr. CROFT, and will be given by Mr SEYMOUR SMITH, assisted by HERR MAX ALEXANDER.—This week a variety of Entertainments, including JANE CONQUEST See Programme. 12 and 7. Admission, 1s.

Now ready, crown 8vo., cloth bevelled, with numerous Diagrams, 15s.,

A MANUAL OF TELEGRAPH CONSTRUCTION:

The Mechanical Elements of Electric Telegraph Engineering.

For the use of Telegraph Engineers and others.

By JOHN CHRISTIE DOUGLAS,

East India Government Telegraph Department, Society of Telegraph Engineers, &c.

"The amount of information given is such as to render this volume a most useful guide to anyone who may be engaged in any branch of electric telegraph engineering."—*Athenæum.*

LONDON: CHARLES GRIFFIN & CO., 10, STATIONERS' HALL COURT.

MESSRS.

H. A. HARBOROW & H. SPAGNOLETTI,

Electric Telegraph Engineers,

CONTRACTORS, AND MANUFACTURERS,

4, CIRCUS STREET, MARYLEBONE, W,

Makers of Block Instruments, Single and Double Needle Instruments, Coils for same with Induced Needles. Lines constructed and maintained. For foreign lines and hot climates, H. and H. S. having for a number of years made C. E. Spagnoletti's Induced Coils, can specially recommend them as less liable to be affected by lightning or other atmospheric changes than any kind made. Makers of the Spagnoletti and Partridge Electrical Tell-tale Clocks for Lunatic Asylums and other large establishments. The S. and P. Train Recorder. C. E. S.'s Self-acting Electrical Semaphore. C. E. S.'s Repeaters for Semaphores, Lamps, &c. Batteries of every description. Electric Bells, Indicators, Thief and Fire Alarms for private houses, banks, hotels, warehouses, &c., &c. Lightning Conductors. All kinds of Electrical Mining Apparatus. H. and H. S. draw attention to their Bells, &c., especially adapted for mines. Models made. Experiments carried out.—4, Circus Street, Marylebone, London, W.

JULIUS SAX,

108, GREAT RUSSELL STREET,

BLOOMSBURY, W.C.

Telegraph, Magnetic, & Electrical Instrument Manufacturer.

Astatic Mirror Galvanometers, Resistance Coils, and all kinds of Testing Instruments.

Electric, Magnetic Bells, and Indicators as applied to Domestic, Official, and Manufacturing purposes.

TIMOTHY MORRIS, Patentee and Manufacturer of all kinds of Electric, Magnetic, Galvanic, Electro-Magnetic, Magneto-Electric, and Thermo-Electric Apparatus, 3 and 4, Market Street, Coleshill Street, Birmingham. Lightning Conductors Made and Fixed on the most Improved Principles.

BECKER AND SONS'

Analytical, Assay, Bullion, and Scientific Balances

AND WEIGHTS OF PRECISION.

SOLE ENGLISH AGENTS:

ALABASTER AND COMPANY,

COMMISSION MERCHANTS,

Importers and Exporters of Scientific Apparatus and Books,

57, LUDGATE HILL, LONDON, E.C.

THE

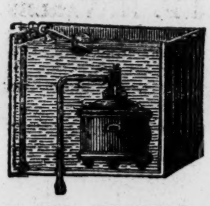
London & General Water Purifying Company

(LIMITED).

PATENT CISTERN FILTERS CHARGED SOLELY WITH ANIMAL CHARCOAL.

Requiring, when once fixed, no attention whatever.

House Cistern, fitted with a Cistern Filter.



And Superior to all others. *Vide* Professor Frankland's Reports to the Registrar General, July, 1866, November, 1867, and May, 1870. The *Lancet*, January 12, 1867, and Testimonials from Dr. Hassall, September 23, 1863; Dr. Letheby, February 15, 1865, and December, 1872.

Price £1 10s. and upwards. PORTALE FITERS on this System, £1 5s. to £3.

Patronised and used by Her Majesty the Queen, at Osborne; by H.R.H. the Prince of Wales, at Sandringham; by H.R.H. the Duke of Cambridge, the *elite* of the Medical Profession, and at the London, St. George's, Fever, and German Hospitals, and various Lunatic Asylums, Institutions, Breweries, &c.

POCKET FILTERS, 4s. 8d. and 6s. each. HOUSEHOLD and FANCY FILTERS, from 12s. 6d.

WATER TESTING APPARATUS FOR DETECTING THE IMPURITIES IN WATER, 10s. 6d. and 21s. each. Danchell's "Testing Apparatus for Discovering the Presence of Impurities in Water" is a most convenient and portable one.—*Vide* Dyke on the Preliminary Duties of Health Officers.

This is a very handy case for the Study Table or Carpet Bag. It contains the Chief Chemical Tests for Qualitative Water Analysis, and will be found of use by medical and other men who may have occasion to ascertain in a ready manner whether any of the more actual impurities are present or not in water.—*Vide* the *Medical Record*, January 29, 1873.

157, STRAND, W.C. (four doors from Somerset House), **LONDON.**

Read—"Water: its Impurities and Purifications," price per post, 2d.

THE TELEGRAPHIC JOURNAL.

Vol. III.—No. 53.

CONTACT *v.* CHEMISM.

The battle of the guages in the railway world has its parallel in the battle of the theories in the electrical world. Volta conceived the generation of the current in his pile to be due to the contact of dissimilar metals. Fabroni suggested that it was due to chemical affinity. The German physicists—amongst whom we may name Ritter, Pfaff, and Ohm—were ranged on the one side, and the English and French physicists—amongst whom we may name Faraday, Davy, and De la Rive—were ranged on the other side. The first phalanx was supported by the undoubted fact that the contact of two metals, such as zinc and copper, does produce opposite electrical conditions; and the second phalanx was supported by the equally undoubted fact that it was possible to produce currents without the contact of dissimilar metals. Volta determined that in every case the more oxidisable metal was positive, and that the relative order of positive electrification followed exactly the same order as that of oxidability, which led De la Rive to attribute the result to oxidation due to the moisture of the air upon the positive plate; but later observers—especially Sir William Thomson—have shown that this result is independent of moisture, or even of the air, and that it is positively stopped if actual water be present. De la Rive went so far as to say that no effect occurred when one disc was well coated with varnish and a platinum wire is soldered on to it, but Peclet showed that he was wrong. Behrens, in 1805, actually constructed a dry pile of 80 pairs, and De Luc, in 1810, made one of 800 pairs, of tinned iron and gilt paper; and Zamboni, in 1812, made one of 2000 pairs, using paper tinned on one side and pasted with peroxide of manganese on the other. More recently, Sir Wm. Thomson has actually measured the difference of potential between zinc and copper in contact.

Davy, though supporting the chemical theory, found metals to be positive when in contact with dry acids, and negative when in contact with alkalies; and many other observers have noticed that contact difference of potential is not due alone to different metals, but to metals and liquids, metals and gases, and, in fact, to the contact of dissimilar bodies. So that we may say that in the whole range of physical science there is no fact more thoroughly substantiated than that the contact of dissimilar bodies determines a difference of potential between them. Now Faraday and his followers, in supporting the chemical theory, rely on the fact that currents are produced without the contact of dissimilar *metals*; but it is evident that, to destroy the contact theory, we must produce galvanic currents without the contact of dissimilar *bodies*,—and this is simply impossible. On the other hand, it is very easy to produce many instances where currents are produced without chemical action. The ordinary form of Daniell's battery in such general use throughout England is a case in point. There is no chemical affinity between zinc and sulphate of zinc, or between copper and sulphate of copper, and yet arrange these materials in a cell and we have the electromotive force of a perfect Daniell's battery. There is no chemical affinity between zinc and chloride of ammonium, but put them in a Leclanché's cell and we have a powerful current. There are many other insurmountable difficulties in accepting the chemical theory, but the chief objection to it is the answer to the simple question—What is chemical affinity? If we accept the contact theory, we not only accept a feasible theory based on an irrefragable fact, but we answer the question—What is chemical affinity? For, accept the fact that the contact of dissimilar bodies determines a difference of potential between them, we can say at once this is the cause of that action called chemical affinity.

It is said that Volta's theory is opposed to the science of energy. So it was in its original form, but in its modified form—where contact is the prime cause and chemism the effect, sustaining the supply of energy—the difficulty ceases. If we admit that chemical affinity and contact electricity are the same thing, all difficulties cease, and both parties to the contest can retire from the field with the conviction that their battles have been fought, like so many other fierce battles, over a mere difference in words.

At a meeting of the directors of the Globe Telegraph and Trust Company (Limited) the following interim dividends were declared for the quarter ending the 18th inst. On the preference shares three shillings per share, being at the rate of six per cent per annum, and on the ordinary shares two shillings and sixpence per share, being at the rate of five per cent per annum. The register of transfers will be closed from the 12th to the 17th April, both days inclusive, and the warrants will be payable on the 21st inst.

The directors of the Western and Brazilian Telegraph Company (Limited) have declared an interim dividend of five shillings per share for the quarter ending the 31st March last, payable on the 15th inst.

The Great Northern Telegraph Company's traffic receipts for the month of March—this year, 362,145 frs.; last year, 364,579 frs. Total traffic receipts 1st January to 31st March—this year, 884,312 frs.; last year, 982,251 frs.

SPECIAL TELEGRAPHY.

The season of "Special Telegraphy" has set in with a vengeance. During the past fortnight there have been no fewer than twenty-three Race Meetings throughout the United Kingdom, for which special telegraphic arrangements of some kind or other have had to be made; and in connection with these meetings upwards of 20,000 telegrams have been forwarded and received. Northampton, where racing has suddenly revived, and bids fair to regain its ancient prestige, heads the list of important meetings. Here, as many as 4600 telegrams were forwarded and received during the two days of the meeting, being a very large increase on the number for the corresponding event of last year. Warwick, an old established stronghold of racing, comes next, with a total of 4344 messages in three days; and then follow Pontefract, Durham, Windsor, Cheltenham, Croydon, Catterick, Irvine, Packington, Abergavenny, and Croxton Park, with totals varying from 1500 down to 450 messages. The mere mention of these names is sufficient to show the universal character of the sport in England and the all-pervading nature of our telegraphic system. In every one of the cases we have mentioned telegraphic business is carried on at the race-course; and, unlike the system of the late Telegraph Companies, by which an extra charge was levied on all messages forwarded from or received at the Grand Stand, only the "uniform shilling rate" is exacted by the Post-Office for racing as for other messages.

During the present week the racing season will be inaugurated at Newmarket, which, as it is the head quarters of the sport in England, is also the head quarters of racing telegraphy. Last year upwards of 75,000 telegrams were forwarded and received in connection with the seven Race Meetings held at Newmarket, being an average of more than 10,000 messages for each meeting. Of these, more than 12,000 messages, containing 625,000 words, were forwarded on behalf of the press, and more than 1500 were forwarded to the Continent and elsewhere abroad. The principal telegraph office at Newmarket would hardly suffer by comparison with those of some of our largest provincial towns, when it is in full swing during a busy week, such as that in which the "Two Thousand Guineas" or the "Cambridgeshire" is celebrated. On the Heath there are no fewer than three separate offices, each adapted to the varying requirements of the racing public and the press, although never more than two are in use at the same time. Before another year, however, the number of offices will be reduced to two, the Jockey Club having at length determined to erect a series of new stands on the race-course, and having agreed to embrace a "Central" telegraph office in their plans.

Next week several important racing events, involving much special telegraphing, have to be decided. The Epsom Spring Race Meeting, when the "City and Suburban" will be the leading event, takes place on Tuesday and Wednesday; and the New Sandown Park Meeting, near Esher, which aspires to be a kind of Metropolitan Goodwood, occupies the remainder of the week. The Epsom Meetings are old-established affairs, and the telegraphic arrangements in conneetion with them are a matter of course, just as they are at Newmarket or Doncaster. Nor will there be any lack of accommodation at Sandown Park, although the race-course is barely yet laid out, and the carpenters are still busy with the "Grand Stand." Already the wires have been carried to within a stone's throw of the judge's box; and by this time next week the means will have been provided whereby the result of the "Grand National Hunt" and the "International Steeplechase" may be telegraphed to London and Manchester almost before the winning number has been hoisted on the "telegraph board." The telegraph department of the Post-Office is not above imitating the policy of the old companies in so far as their quest after profit was concerned; but it has taken care to secure popularity as well as profit in its operations, and it has certainly shown wisdom in not handicapping its business in connection with Race Meetings with the objectionable surcharges of the early days of telegraphy.

A NEW DIRECT MEASUREMENT GALVANOMETER.

By J. T. SPRAGUE.

Some remarks in the review (Tel. Journ., p. 83) of my new book—"Electricity, its Theory, Sources, and Applications"—seem to call for an explanation in these pages of the galvanometer of my invention, which the reviewer, somewhat sarcastically, calls a "combination of the admirable Crichton and the wonderful calculating boy."

As to the suggestion that it is a pity that the issue of the book was not delayed so as to allow a description of the instrument, I would remark that the book does contain a sufficient account of it, but that I did not feel it desirable to give such a close description of its actual construction as to enable my readers to make too easily for themselves an instrument on which I have expended many months of work, and gone to the expense of patenting in hope of some repayment for that work. Those who desire a full description will find it in the published specification; for the instrument is not a mere idea, as the reviewer probably supposes, but a completed instrument, which has been subjected to every test. When I speak of it as "*soon to be accessible to the public*," I refer merely to its actual manufacture for sale, which has been deferred because I am not myself engaged in business, and have not (owing partly to illness) as yet arranged for its manufacture and introduction by others. There is therefore no reason why I should have delayed the book, the publication of which has been so long and so often asked for by readers of the papers on which it is based.

The galvanometer is based upon an idea which, when explained, must become obvious to every electrician: it is simply a mechanical application of Ohm's formula—

$$C = \frac{E}{R}.$$

A Daniell's cell is $E = 1{\cdot}079$: if we apply it to a tangent galvanometer with a total resistance of 1·079 ohms, we get a deflection which may be 1 or 50 degrees upon any particular galvanometer, according to its nature, but which, whether 1 or 50, is certainly indicative of a current of 1 veber per second. My idea is, therefore, to make this the starting-point of graduation instead of mere degrees of arc, and the result is that, whatever the electromotive force or resistance of any other circuit, whenever the conditions are such by Ohm's laws as to give a Veber rate of current, my galvanometer shows it as such, and so for any other current. Therefore any observations made by one person are available for any other, whether their different instruments be constructed for large or for small currents. Now, I have explained in my book how any one can graduate their own instrument on this system if they please, but I cannot conceive what objection there can be taken to my remark that no one must make instruments so graduated *for sale*, because I have patented it. It is possible I may be incorrect in my remark quoted as to this principle of graduation, that no one appears ever to have thought of it as applicable to galvanometers, but certainly I have never seen the idea mooted in any of the many books or papers I have read, nor have I ever seen or heard of any instrument so graduated. I once asked one of our most celebrated instrument makers why galvanometers were not made to show the current in actual units? and he seemed disposed to laugh at me; at all events he told me it was not possible, although my own galvanometers had been so graduated for some time.

Now, with a Daniell cell of constant electromotive force of 1·079 employed, it is obvious that any given current shown by this instrument implies of necessity a given and fixed resistance, and therefore I have only to graduate my instrument so as to show this resistance. Again, if I insert any cell or battery whatever, and make the resistance 1 or 1000 ohms, is it not certain that the current shown in vebers corresponds exactly to the electromotive force producing the current?

The idea once explained, it must be obvious to any one as regards the tangent galvanometer; but I have carried it further. I have found out, by a multitude of experiments, how to construct an ordinary flat coil galvanometer with several circuits so arranged that I can obtain multiplying powers of 1, 10, or 10,000, and thus have made an instrument which can be used to measure such a current as is needed for the electric light, or such as would be given from a single cell through the Atlantic cable, both in vebers, and then, by a slight change, the most delicate traces of electricity.

But any definite current has its fixed equivalent in chemical decomposition, and this the Veber unit disguises. Now I have not, as the reviewer says, renounced old units, and *in place thereof* introduced new ones, but have simply proposed—for all those uses which are related to Chemistry—a simple unit of quantity based upon the chemical relations of electricity, that which affects one equivalent of chemical work of any kind measured in grains, which would, for instance, release 1 grain of hydrogen or 108 of silver. This is the same unit which Smee used, and corresponds to one frequently used by continental writers, viz., a chemical equivalent of 1 decigramme. A unit of current and one of energy complete a system with many points of superiority over the merely mathematical system of the British Association units, as I have fully shown at p. 145 of my book, because it is correlated to the natural constitution of matter, and to its relations to energy, instead of to merely arbitrary human inventions, such as metres and grammes. As a consequence, the graduation of my galvanometer in chemical units converts it into a voltameter, and indicates at once the general chemical work doing, while for special uses it can be graduated to any particular work desired, because any such work has a known and definite relation to my unit of quantity and current.

I shall be happy to show my galvanometer at work, and under any test, either to the reviewer or to any other gentleman who will call upon me in Birmingham, giving a day or two notice in case of my absence from home, and hope soon to be able to make it—as I mention in my book—*accessible to the public*, that being now simply a matter of business arrangement. Once it is so, its convenience and utility will be evident.

HARRISON GRAY DYAR.

Another old electrician has been taken away in the 69th year of his age.

Residing in Europe from 1831 to 1858, and, since that year, in retirement in the United States, Mr. Dyar was comparatively unknown to the present generation, but in 1826-27 he became widely known by his experiments in the then mysterious and unknown paths which afterwards developed the electric telegraph. He anticipated Morse in the introduction of the telegraph into America. In 1828 he erected a line of iron wire on wooden posts with glass insulators, at the old Union Race Course, on Long Island, which he worked successfully with static electricity (the constant battery not having at that time been discovered), the currents transmitted discolouring litmus paper, which was placed in the circuit upon a moving disc or table. We have no record of the length of this line, but the results obtained were deemed so satisfactory that it was determined to build a line from New York to Philadelphia. This project was, however, abandoned, owing to disagreements which arose between his associates and himself. Mr. Dyar had amassed an ample fortune from his scientific pursuits in Europe, which was largely augmented by real estate investments in the City of New York. Personally he was a gentleman of refined and studious tastes. He was born at Boston, Mass., in 1805. He died in Rhinebeck, N.Y., on January 31st, 1875.

Coloured Shadows.—Mr. C. T. L. Whitmell, in *Nature*, writes: Six Grove's cells were connected with one of Ladd's large induction coils, and the secondary current, condensed by two large Leyden jars, was sent, in the usual way, between two pairs of metallic electrodes, in order to examine their spark spectra. Two of the electrodes were of platinum; these may be called pair A. Of the other pair, B, one electrode was of platinum, and the other of the metal to be examined. Place a piece of white paper equidistant from, and on one side of, the two sparks. Hold the finger so that a shadow of it may be cast by each spark. The two shadows will be seen to be most beautifully tinted with different delicate colours, varying according to the metal inserted in B. It will be seen that the shadow thrown by A is lighted by B, and is seen on a ground jointly illuminated by A and B; whilst B's shadow, lighted by A, is seen on the same common coloured ground as before. Without these considerations it might have been supposed that the shadow thrown by B, and lighted by the unchanging spark A, would itself have remained unaltered. I saw it of the colours, pink, light pink, dim pink, light green, nearly white, and yellow-green; corresponding to the introduction into B of Bi, Ag, Sn, In, Al, and Mg respectively,

THE VOLTAIC BATTERY.

A Course of Six Lectures,

By Dr. JOHN HALL GLADSTONE, F.R.S.,
Fullerian Professor of Chemistry, Royal Institution.

Delivered at the Royal Institution of Great Britain.—Christmas, 1874-5.

Lecture IV.—The History of the Battery in its Various Forms.

The history of most human inventions is lost in a mist of obscurity; but it is not so with the voltaic battery. The fact is there are many friends still among us who are older than it. We know all about its origin, and my purpose here to day is to endeavour to trace not merely its birth, but its youth, and how it grew up to its present strong maturity.

Towards the close of the last century there was a physician at Bologna of the name of Luigi Galvani, a man celebrated for original experiments in Anatomy and in Electricity. It so happened that his wife was an invalid, and on one occasion she wished to make some broth of frogs. Now, in preparing frogs for food, you know, they cut off the hind legs of the frog, and some of these hind legs happened to be upon the table, and electrical apparatus was near them. Signora Galvani observed, much to her astonishment, that on bringing a knife near to one of the legs of a frog they were convulsed. She drew her husband's attention to this, and he investigated the matter more fully. He found that it was only when the knife touched the great nerve of the leg connected with the backbone—the crural nerve—that this convulsion took place, and he found also that it only occurred when there was the spark from the machine. But he made other observations beyond that. He thought that if the electrical machine did this, atmospheric electricity ought to do the same. And so he hung up some frogs' legs upon an iron railing near his house, by means of a copper wire passing through or behind the nerve; and then, to his astonishment, he found that it was not necessary to wait for lightning,—for even when the wind blew, and the feet of the frog kicked against the iron railing, the convulsion took place. Now I wish to show you that experiment. I think it is worth while that you should all see it, and see it well. Of course I do not wish you to repeat the experiment, because it kills the frog; but I suppose that not any of us who are in the habit of eating animals in our daily food will scruple to kill an animal for mental food, in this way, and for the purpose of illustrating one of the most important events in the history of Science. Seeing it once, you will not need to commit any cruelty in repeating it. I may tell you, while the frog is being prepared, that the explanation of Galvani was erroneous in the matter. He thought that this frog was something like a Leyden jar. Those of you who have studied frictional electricity will know that instrument. He thought, further, that the frog was a very delicate electroscope, and had the power of charging itself and discharging itself by means of the metals. This was an erroneous opinion of Galvani, and, like most erroneous opinions, it prevented him from getting as much good from his experiment as he might otherwise have done.

In exhibiting the frog we shall throw the oxyhydrogen light upon it, so that it may be visible to you all, and we shall cast the shadow on the screen, so that those who may not be in a position to see the legs will see the shadow of them. I have here the means of making contact between the copper support and the iron railing through the frog. Upon joining these we shall see the convulsion taking place. See how it kicks in various directions. That is just what Galvani saw, and what surprised him so much. But now we will take a piece of zinc, and see whether we cannot produce the same convulsions; for Galvani tried his experiment in various ways. We will make our frog sit up, if we can, on the zinc. When the copper wire touches the zinc let us see what will happen. The nerves of the poor dead frog have still such activity about them that the legs kick directly the copper and zinc are brought into contact with one another. In 1781 Galvani published these experiments at length in a Latin treatise. They at once drew a great deal of attention to the subject, and they were discussed and criticised by very many. Volta—another Italian, a professor of natural philosophy at Pavia—made experiments upon the subject, and he considered that the explanation of Galvani was unsatisfactory, and that the convulsions had nothing to do with animal electricity. He thought that the secret lay in there having been two metals concerned. You see, there were iron railings and copper wire; and Galvani always found that, to produce the effects well, he had to take two metals and join them together. Now Volta said, very rightly, Why these two metals? There must be something mysterious about the junction of the two; and Fabroni—a professor at Florence—suggested that chemical action might have something to do with the matter. Volta worked at the subject very diligently, and, to prove the importance of the junction of two metals, he produced his celebrated pile. That was the first battery ever formed. We have the pile here. It consists of copper and zinc plates soldered together, and between the pairs there are pieces of flannel or cloth steeped in salt. Acid was sometimes used afterwards, but not, I believe, by Volta. He made a pile of these pieces of metal. We have here fifty-six piled one on top of another, with this salt flannel between them. By taking the two ends—or rather by taking the wires attached to the two ends—we can produce, I dare say, various effects. We can get a spark as you see, and we ought to get a shock very easily by means of this arrangement. I do not know whether we shall be able to make our frog move. [The wires of the voltaic pile were brought into contact with the frog's legs, and produced a sudden convulsion.] Thus you see, at once, the effect produced by means of a pile, which consists of the junction of two metals. Volta, in this way, got Galvani's effects. This pile may be easily imitated by yourselves by putting together almost any pair of metals. You join the two ends, and then you get the effect,—an effect much more powerful when you have a great number of plates. This pile was built up by Volta first in 1799, and he wrote an account of it, and sent it to England to Sir Joseph Banks, the president of the Royal Society, in the beginning of the year 1800. This drew the attention of English experimenters to this subject, and they were soon very fruitful in results.

For instance, there were two men—of the name of Nicholson and Carlisle—who made hastily a pile of zinc plates, copper penny pieces, and pieces of pasteboard damped with a solution of salt; and with this very rough pile they perceived, on bringing the two ends together, that there was an odour about the poles, and this odour they recognised as one which generally accompanied hydrogen gas, and therefore they thought that there was a decomposition of water. This led to other experiments on decompositions, and so they found out, for the first time, that electrolysis of which I spoke in the last lecture. These were, in fact, the first experiments in electrolysis. I must give you the date of them. It was on the 30th of April, 1800, that these experiments were made with the voltaic pile.

We have traced voltaic electricity to England; but let me go back to Italy for a moment. We find that there were two persons concerned in this branch of knowledge,—Dr. Galvani and Volta,—and sometimes the name of one is applied to this force, and sometimes the name of the other. Sometimes we speak of Galvanism, and at other times of Voltaic Electricity. The apparatus is called either the galvanic battery or the voltaic battery, and I did not know at first which term to employ as the title of my lectures; but I chose "The Voltaic Battery" in place of "The Galvanic Battery,"—not that Galvani has not the priority in observation, but that the battery belongs rather to Volta. Galvani never made a battery, and he so misunderstood the force which he had got hold of that he would never have made one. But Volta had a more scientific mind, and he saw that there was something remarkable in the contact of the metals, and that it was not simply an animal phenomenon. And therefore he built up this pile, which is the infant,—the baby,—the very commencement of these various piles which are so powerful, and which we can now exhibit before you.

It so happened that in the same year in which the voltaic pile was known and experimented upon in England—the year 1800, the first year of this century—Davy was appointed Professor of Chemistry in this Institution. He had paid some attention to this matter before he came up from the west of England, and when he came to London he threw his heart and soul into the investigation of this voltaic force. The first course of lectures that he ever delivered in this Institution was upon the voltaic pile and its results. They were lectures delivered in the evening, and they established, to a certain extent, the fame of this young lecturer—Davy. Later on in the year he delivered another course of lectures, which, being in the morning, were attended by the fashionable *élite*, as well as the thoughtful people of the day, and they increased greatly the fame of the philosopher. Davy, in setting to work, appeared to form a sort of determination to tear to pieces everything he could by means of the voltaic power. Of course he was not content with this original structure. In fact, Volta himself improved upon it considerably, and formed an arrangement which I have here, which is called the "Crown of cups." This is an improvement, and is much more convenient than the pile. In fact, the pile is a very inconvenient arrangement. In the improved form you take copper and zinc, and solder them together, connecting them by means of a wire, and then you put them into the cups, or glasses, or jars, in such a way that the piece of copper goes into one jar and the piece of zinc into the next. This is what we call a "couple." The copper of one couple and the zinc of the next couple are in the same jar. You see there is no action between this zinc and copper at all, at present; but if I take the wires at the ends, directly I join the two, you will see that there is an action taking place in all the jars. It is just as if I had joined the plates in each jar. There is now hydrogen being given off in each case. This shows how we can combine many plates together, and in this way we get a much greater intensity of force than we can from any single couple,—more than we could, in fact, from the very large couple which I had in the middle of the room at the first lecture.

Then there was another way of arranging the batteries, which was considered a very great improvement. The plates were soldered together, and put in a trough like this. You had to pour sulphuric acid upon the plates, and then the whole thing was ready for action. There is a wire connected with each end. This is part of the "trough battery" which Davy used. He employed five batteries like that for the decomposition of potassium—the experiment I spoke of in the last lecture. These are called Cruikshank's batteries.

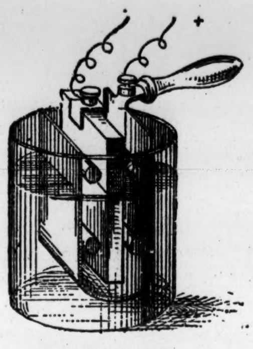
But Davy was not content, even, with his five batteries, which had won for him so many laurels, in the decomposition of the alkalies and alkaline earths. He wanted a larger battery still, and a subscription was set on foot in this Institution, money was collected, and a battery was formed of two thousand double plates. Each plate had 32 square inches of surface, so that altogether there were 128,000 square inches of active surface. What a prodigious amount of power he had here! It is said that it gave a spark, between charcoal points, of 4 inches in length. It was charged with dilute nitric acid. With this very celebrated powerful battery he was able to perform various work in this building, and he thought he could decompose almost everything, but there were some things that resisted even Davy. Of course everything that is simple, and not compound, would resist decomposition; but then he did not know what was simple and what was compound until experiments were made. He, therefore, had a hope of decomposing nitrogen, and he wrote to Mr. Jordan in this way:—"I hope to show you nitrogen a complete wreck, torn to pieces in many ways."

But I must hasten on. Dr. Wollaston, who was well known as a scientific man in those days, made an improvement, by putting the copper on each side of the zinc. Then he could take his cell and put it into dilute sulphuric acid, and, of course, it was acted upon on both sides. You see the great effervescence there is—the great number of bubbles, and this piece of connecting platinum wire has become red hot. Here, then, with a single cell of Dr. Wollaston's, we are able to make a piece of tolerably stout platinum wire incandescent. But Wollaston was not content always with a big thing like this. He had an idea of making very small batteries, and his celebrated battery was in a silver thimble. He took a silver thimble, flattened it considerably, and cut off the end,—that part which is at the end of the finger,—then he put between the two sides a little piece of zinc which was ¾ of an inch square, and then taking some exceedingly fine platinum wire—which he had a special way of making—he was able, by joining the two sides of the flattened thimble to the zinc, to make his little piece of platinum wire red hot. Thus he was able to show this remarkable effect of galvanism by means of his little silver cell. But while Dr. Wollaston was fond of his small battery, there was a Mr. Children who made a very large battery. His plates were 6 feet long and 2 feet 8 inches broad; there were twenty-one cells, and he had to have ropes and pulleys to move these gigantic plates, with which he experimented. But if I were to go minutely into the history of the whole matter it would take me a great many hours instead of one. I will just simply mention that most of those who experimented upon the subject added something to our knowledge of the best forms of battery. Faraday made certain modifications; Mr. Hart made an arrangement by bending the zinc round the other metal in the way that we have it here. Mr. Warren De la Rue was the first, I believe, to employ sulphate of copper. And I will here mention, also, Smee, though he came a little later. Mr. Smee formed this combination, in which he had a zinc plate on each side of a silver plate, but the silver has a little powder of platinum deposited upon it. This is a powerful arrangement, especially useful for electrotyping. Perhaps we may say something more about it when we are speaking of that subject in the next lecture. But the principal advance was made by Prof. Daniell, of King's College. He found that the batteries grew weak, and that they did so from the deposition of hydrogen gas upon the zinc, and thus he was led to devise some means by which to get rid of the hydrogen gas. Here is his battery (see p. 91). I think I will show you first of all this battery, which we can take to pieces. There are two cells, one much smaller than the other, and the smaller one is porous. In the outer cell he placed a copper cylinder, and within that again tae porous cell, and inside that cell he put a bar of zinc; then he filled the inner cell with sulphuric acid, and the outer cell containing the copper cylinder with sulphate of copper. On joining the two metals by a wire there is an action through the porous cell, and copper is deposited upon the copper cylinder, and thus no hydrogen is formed at all. It is just as we see it here in the former drawing representing an electrotyping apparatus (see p. 50). Through the kindness of Prof. Adams, of King's College, I have here one of the original cells constructed by Daniell. It is rather more complicated, and very curious in an historical point of view. This is a square, instead of a round, zinc bar, and instead of having a porous cell he first used an ox's gullet. He wanted a stream of sulphuric acid to flow through it, and therefore he had a funnel over the ox-gullet, and a pipe below to carry off the liquid. He joined a good many of these together, round one central reservoir. This, then, is one of Daniell's first attempts in making his well-known battery. Here is a Daniell's cell actually fitted up, such as is used now-a-days. It is just such as I described before, except that—instead of having a glass vessel outside, and the copper cylinder inside it—the copper plate itself forms the outer cell. Daniell's battery was made in 1836; Wollaston's was constructed in 1815.

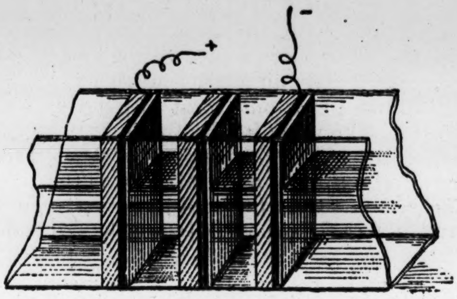
But, very shortly after Daniell introduced this improvement, Mr. Grove—the present Sir William Grove, or Justice Grove—made an advance upon this battery by using other elements. This was done in the year 1839. Here is a Grove's cell. He took a glass vessel, and adopted the plan of bending the zinc which had been suggested before, together with the porous cell of Daniell, and a sheet of platinum. He put the platinum in the porous cell, between the two sides of zinc, and these were made of such a form as to be easily fastened together. As for the liquid element of this battery, the outer cell is filled with sulphuric acid, and the inner one with nitric acid. The nitric acid also prevents the formation of hydrogen; for another gas is formed—a gas which is red in colour, and which, I think, we will produce otherwise. Let us take some nitric acid, and decompose it with a little copper. In this case, you see, we produce intense red fumes. I have taken away part of the oxygen from the nitric acid, and this dense red gas rises up at once. The fumes are very unpleasant, so we will put away the vessel from which they are issuing. This is, in fact, one of the disadvantages of the nitric acid battery. But the advantage is that we get a great amount of power, and we have it very constant, because there is no hydrogen to interfere with the continued action.

I have below a galvanic battery, in which several Grove's cells are joined together, and I hope to show you one or two experiments which I was obliged to leave out in former lectures. In the first lecture, for instance, I intended showing you how we could produce various convulsive movements of the nerves and muscles. Some of you saw that, because you were good enough to come round the table, and try that little arrangement by which we could give the shocks to human creatures; but not many of you felt those shocks, and I do not think that many witnessed the effect. We have now an eel to experiment upon. We were unable to get an eel last Tuesday, as the weather was too cold, and it was said that the frost had killed all the eels at the fishmongers' round about: but the weather has moderated, and a live eel has been obtained. Here is a Grove's battery. You see there are several cells joined together, so as to carry on the force from one to another; and here is our eel quietly resting at the bottom of this vessel of water; but I dare say that, when we send this force through the water, we can make our eel feel very uncomfortable. [A current from the Grove's cells was passed into the water, and the eel immediately leaped out of the vessel to the floor of the theatre.] The eel had an exciting moment of it, so you must not be surprised at the vigour with which he moves. We made no arrangement for a strong shock: indeed, we ourselves could scarcely have felt the shock that made all this disturbance in the equanimity of the eel.

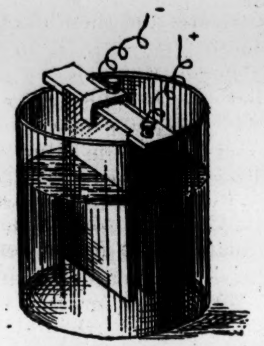
You may remember that, when speaking of electrolysis, I wanted to show you the decomposition of some alkaline salts in solution, but there was no time. I will, however, show you some decompositions by means of this arrangement. Here is a liquid containing chloride of sodium—common salt—and by decomposing that we ought to produce sodium on the one side, and chlorine on the other. Common salt is made of two substances—the metal sodium, and the element chlorine.



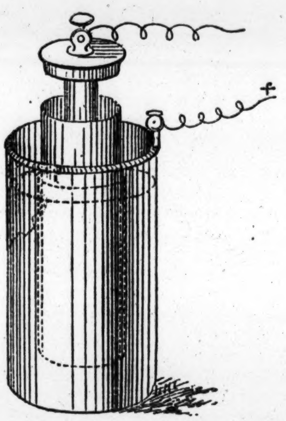
Wollaston's Cell.



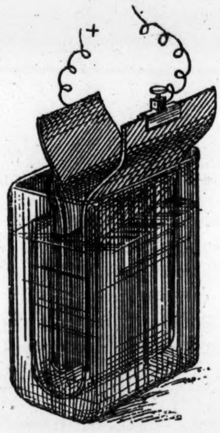
Cruickshank's Battery.



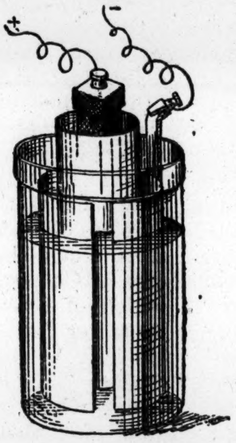
Smee's Battery.



Daniell's Cell.



Grove's Cell.



Bunsen's Cell.

I spoke, you may remember, about the various ways in which things were decomposed by the current. I used the word "current" just now. I dare say I have used it before. We are obliged to use words which convey, perhaps, erroneous ideas, and it is very difficult for us to get rid of the tyranny of these words. So I would ask any of you girls and boys to be particularly careful about the words that you use, and to think what is the real meaning of these figures of speech. We cannot help using figures of speech, and I must speak of a current. Well, a current means something that runs like a liquid. In early days they frequently spoke of the "electric fluid," as though something flowed through these wires, and this misled people into the idea that the wire was something like a pipe with water or gas flowing through it. Some of you may think it is difficult to imagine that anything passes along unless there is some material substance going through the wires. I recollect when I was a young scientific man, talking with an old gentleman, who insisted that he could not understand how any effect could be produced unless something flowed along the wire. At last, not being able to convince him, I said, "Do you imagine that when you pull a bell-wire there is a mechanical fluid running through the wire to the bell at the other end?" But he was not prepared to think of a mechanical fluid, and so, perhaps, he gave up his idea of an electrical fluid. Perhaps there is some change taking place in the wire itself—some mechanical or rather molecular change, just as when we pull a bell-wire we know that there is a mechanical change going on all through the wire. So there is, perhaps, some molecular change going on all along the copper wire. What is going on in the case of the solution of salt? There is some change which is producing a great bubbling, whatever else it is doing here; and we shall find, I have no doubt, that, on one side, the chlorine has destroyed the colouring matter that is mixed with the salt; and on the other side we shall find an effervescence due to the sodium. There, I think you will see, at any rate, even now, that there is a difference of colour between these two sides, and that in one case a bleaching has taken place. Here we have iodide of potassium with a little starch. When iodide of potassium is decomposed by the voltaic force, the blue iodide of starch will be formed. Here it is revealing itself by means of its deep blue colour. Here is some sulphate of soda which we will endeavour to decompose in the same way. We might really go on with these experiments *ad infinitum.* When we take such a salt as this, the decomposition will form acid on one side, and alkali on the other, and so we shall have a change of colour in the litmus almost immediately. The white paper behind the glass vessel will help to show it better. While we are speaking of the current going through the liquid, you must understand that there is nothing actually flowing, but there is a force at work. We are obliged to employ these figurative terms and expressions.

I have not referred, as I might have done, to these diagrams. I hope you have been looking to the drawings of the different batteries while I have been speaking of them. The current is represented as coming from the positive metal, and going to the negative metal through the liquid. We assume that the motion takes place in that direction. And we can always tell which is the direction, if we have a magnet suspended over the wire. I will tell you a way in which you may know it. If we place our arm and hand, palm downwards, along the wire, in the direction of the current, then the north end of the magnet will point in the direction of our thumb, or I may give an explanation such as was given by the great Ampère, who worked out the mathematics of this matter so fully. He supposed that some little fairy or sprite was swimming along with this current; then his left arm would always indicate the direction in which the north of the magnet pointed.

We have two things to consider in these different batteries. One of these is the force which is started by means of the two metals—either the one metal replacing the other, or the two metals which are brought in contact with one another. This is what we call the "electromotive force," and it differs for every two metals that we put together.

Here is a cell of the Maynooth battery, which is essentially the same as the Grove's battery, except that it has a plate of iron instead of platinum, and therefore it is much cheaper. Bunsen, adopting the suggestion of Cooper before him, took coke or charcoal, which of course is also much cheaper. The coke is either derived from the gas works, or is made artificially by roasting a mixture of charcoal and sugar. The ordinary form of Bunsen battery is this: where we have an external cell with a cylinder of zinc, and within it a porous cell with a bar of coke inside. By joining them we get a very powerful battery. The electromotive force between the coke and the zinc is the greatest of all. If we take the power of Daniell's cell as 10, Bunsen's is 16½, and Grove's is 16—very nearly as much—whereas Wollaston's arrangement is only 4. But we have to think, not only of this force which is started, but of another thing, because there is a great deal of work to be done. The force has got to pass along all the wires, and what is much more serious, it has to get through the liquid itself, and the porous cell: and so we have to consider what is called "resistance"—the resistance inside the battery, and the resistance of the wire that is outside, and anything else in its path. Now the resistances have been measured very accurately by those who have experimented on the subject, and I have put here some numbers representing the power of conduction carefully determined by the late Mr. Matthiesen and others:—

Silver	100·000
Copper...	99·950
Gold	77·960
Iron	16·810
Platinum	11·600
Mercury	1·600
Coke	0·025

Silver is the metal that conducts the best, or in other words, offers the least resistance. This force that we are dealing with must pass along by means of something or other. It cannot go along the air, for that is about the most impassable of all bodies to it. But that kind of substance which offers most resistance to us, such as iron bars and bolts, offers free passage to the electric current; so that, instead of its being caged in by metals, it escapes most rapidly by means of them. Silver, as I have said, has the greatest power of conveying the current, and we represent it by 100. Copper has very nearly the same power; gold about three-quarters; iron much less; platinum still less; and mercury least of all those metals. Coke, which is used in Bunsen's battery, has only a comparatively small amount of power to allow the current to go through. You know the common meaning of the word "resistance;" you know, for instance, how much more easily you can go along when you are skating than when you are walking along the ground in the ordinary way. When you are skimming over the surface of the ice, there seems to be no resistance to your progress, except the air, which presses against your body. You flow along with the greatest ease. Now that is something like electricity going through silver. But if you walk through mud or thick snow, there is a large amount of resistance, and you go laboriously; and if you walk through bushes, the opposition to your progress is still greater; and if you come up against a stone wall, a much more serious opposition will be offered to you, and you will be stopped altogether. So it is with this electric force. There are some things which allow it to pass very easily, and other things which stop it altogether; and so between silver, which allows it to pass freely, and sulphur, which stops it altogether, we have a great number of things which allow it to pass more or less readily.

I am sorry the time is passing away so rapidly, because I have other things to show you in the way of batteries; but one cannot say everything in an hour. Here is a chromate of potash battery. It contains chromate of potash and sulphuric acid mixed together, so that it is, more properly speaking, a chromic acid battery. This form is sometimes used for ringing bells. Here we have Leclanché's battery, which is much employed in the Post Office Telegraph Service. We have one of the telegraph batteries in the room. In this battery of Leclanché we have coke with oxide of manganese as the negative, and zinc as the positive metal; while chloride of ammonium is the binary compound in solution.

Beyond these I must mention some other kinds of batteries. Every voltaic cell must consist of three things, I believe; but that they should be two metals and a liquid is by no means necessary. Here is a decomposition taking place with two liquids, sulphuric acid and sulphate of copper, and one metal copper; and here is Grove's gas battery, in which oxygen and hydrogen are used to produce the effect. Here is an air battery which Mr. Tribe and I have been working with, which illustrates the principle, of which the gas battery is an instance. The oxygen of the air acts along with the liquid nitrate of copper that is between the plates; and we are able to produce here another kind of chemical action, which I certainly have not time to explain to you now. Exclude the air which is floating round about us, and this battery will cease to act; but while the air is playing upon the silver, if the junction with the copper is made, the battery is in action.

The last form of battery to which I shall refer is one which, instead of a metal, we have a compound of a metal—chloride of silver. Yesterday, Dr. De La Rue kindly showed me his great battery, which is made with a thousand cells of zinc and chloride of silver, and solution of chloride of sodium. Here are twenty of these cells. By joining the wires we can get some effect. In fact, with this little voltameter, I shall be able to show you some gas very quickly produced by the decomposition of water. Dr. De La Rue has a thousand of these little cells all in one case; and he showed me, yesterday, some very beautiful effects by means of vacuum tubes, such as I showed you in the first lecture, with those floating bands and striæ of light.

I should have liked to speak to you further upon resistance and such matters, and to show you how you may calculate the power of these batteries, and how, by arranging the cells differently, you may vary the power, and either have a large quantity, or a high tension, so as to overcome a great amount of resistance. The strength of the battery depends originally upon the electromotive force, which is the relation of these metals one with the other; but of course it is diminished by the obstacles to be overcome, and we have simply to divide the electromotive force by the resistance, and then we get the strength of the battery. If any of you who are mathematicians like to enquire further into the matter, I shall be happy to tell you afterwards more about it.

But I want to show you that this power must be very common in nature. I have given you an historical account of the matter, starting with Galvani's experiment on the frog. I have shown you the voltaic pile, and I have traced the battery up from it through the most important forms which it has assumed. There are many other modifications which I have not had time even to mention. But, in fact, we are constantly producing these chemical changes that give rise to voltaic currents, and I want to show you, as the finishing experiment, that most likely, while we were eating our lunch to-day, we were having currents running through us, and were being shocked as the eel was, only to a vastly smaller extent. Here I have an ordinary beefsteak, and an ordinary silver fork. Now if I take a steel knife with this silver fork, I get two different metals. Well, there is an electromotive force when I make the two metals touch; and if I put my fork into the beefsteak, and then cut the steak with the knife, I am sure that there is some chemical change going on between the knife and the fork, because the two are in connection one with the other, at one end through my body, and at the other end by means of a liquid which can be decomposed. I will put my finger on the steel part of the knife, and I hold the metal fork, and thus there will be a current passing through my body. Now I can show that my means of a magnet, if I attach a wire to the knife, and another wire to the fork. Sir William Thomson made an exceedingly delicate instrument for showing the current. This is the instrument. You cannot see the face of it, because we want that for another purpose; but there is a little magnet suspended in the middle of that coil of wire, and upon that is fastened a very light mirror. Upon this mirror the light from the lamp is now being thrown, and it will be reflected by the mirror to the screen. Now, supposing we make the magnet turn, we shall find at once that the mirror will move. We have thus a very long arm of light, which will show if the magnet turns only to a very small extent. This arm of light weighs nothing whatsoever, and so we are able to magnify an exceedingly small movement of an exceedingly small magnet, into something which is visible to all. This "galvanometer" is an instrument which is actually used in the Atlantic Telegraph. You will please watch the mirror. At present our connection is not made, and there is no movement in the spot of light. [The mirror galvanometer just described was attached by means of wires, to the steel knife and silver fork. The fork was inserted into the steak, and immediately upon the knife being brought upon the meat in the act of cutting, the passage of a current was indicated by a movement of the reflected beam of light.]

You see there was a current produced directly I began to cut the meat. We will now reverse the current, and I expect that we shall find that the light will go in the other direction. [The current was reversed with the effect anticipated.]

There, off goes the beam of light towards that little girl at the corner of the front bench.

Notes.

We have to deplore the loss of one of the most amiable and able mechanical electricians of the day. Carl Ludwig Christian Becker was born at Ratzeburg, in the Grand Duchy of Mecklenburg-Strelitz, in 1822. He received his general education at the Gymnasium of Ratzeburg, of which his father was the rector. Having studied his profession with Rephold at Hamburg, Kraft at Vienna, and Steinheil at Munich, he came to London in 1849, and joined the firm of Elliott Brothers in 1858. Within the last few years he became a Fellow of the Royal Astronomical and Physical Societies, and a Member of the Society of Telegraph Engineers. He died April 3rd, 1875, of bronchitis, after an illness of ten days. His place cannot easily be filled, for he combined the refined skill of the brilliant mechanician with the deep insight of the cultivated man of science.

The members of the Staff of the Central Telegraph Station—T.S.—have started a periodical called "The St. Martin's Magazine," which has now reached its fourth number, and which is exceedingly well put together. We wish it every possible success and prosperity. Philology, poetry, ethics, history, fiction, literature, and *on dit*,—all find a place in its well-printed columns. It commenced its existence in manuscript, but its success has been such as to justify the assistance of the printer.

The Dartmouth and Guernsey cable has been again interrupted: the fracture is close to the Guernsey shore, and within the points where it was previously broken. We have not up to the present heard of any steps to effect the necessary repairs.

The Scilly Isles cable has, we believe, a fault in it, but not sufficient to interfere materially with the working. It is supposed to have been caused by a wreck, and the faulty piece will be shortly cut out and the cable restored to its original condition.

The Hon. William Orton, President of the Western Union Telegraph Company, has very recently arrived here from America, on account of business in connection with his Company. It is intended to duplicate the present cable between Punta Rarsa and Key West, and the arrangements for the manufacture and laying this cable forms the principal object of his journey.

The quadruplex question in the United States has recently occupied the attention of Mr. John M. Thacker, the Commissioner of Patents, as regards the question—"The issue before the Commissioner is, to whom shall the patents be granted?" After a lengthy review of the question in its various bearings, he finally decides—"The applications are remanded to the principal examiner, and the patents will issue to Edison and Prescott, as assignees of Edison."

The following is recommended by a correspondent as a cheap battery:—On the bottom of a cylindrical glass jar place a circular disc of iron, having an insulated wire soldered to it. Cover this disc to a depth of about an inch with crystals of copper sulphate. Fill the jar to within an inch of the top with water, and suspend horizontally another disc of iron in the water. Such a battery is said to work household bells for twelve months. We doubt it.

Telegraph clerks will hear with alarm of telegraphic paralysis, a new malady reported by a French physician to the Académie des Sciences. An *employé*, who had been engaged in a telegraph office for nine years, found that he could not form clearly the letters U, represented by two dots and a stroke, I, by two dots, and S, by three dots. On trying to trace the letters his hand became stiff and cramped. He then endeavoured to use his thumb alone, and this succeeded for two years, when his thumb was similarly attacked, and he subsequently tried the first and second fingers, but in two months these were also paralysed. Finally, he had recourse to the wrist, which also shortly became disabled. If he forced himself to use his hand, both hand and arm shook violently, and cerebral excitement ensued. It appears that this disorder is very common among telegraph clerks.—*Graphic.*

We are sorry to record the failure of that well-known and much-respected telegraph engineer, Mr. W. T. Henley. The state of his affairs has not yet been published, and we sincerely trust it will not, but that he will tide over his present difficulties, and have his large works in full operation again.

The annual *conversazione* of the Royal Society, held on the evening of the 7th inst., at Burlington House, was, as usual, brilliant in the gathering of scientific celebrities and apparatus. Prof. Barrett illustrated his discovery of the after-glow in cooling iron wire, and Gore's discovery of the anomalous deportment of iron wire when made red hot by a current. Mr. Culley exhibited Edison's electro-motograph. Mr. Apps showed some beautiful effects with his unrivalled induction-coils. Mr. Ladd showed Dr. Lombard's thermo-electric apparatus. Messrs. Siemens exhibited a model of the *Faraday*, a fragment of basalt and two other stones brought up by a grapnel from 2400 fathoms depth, in the North Atlantic, probably dropped by some passing iceberg. Mr. Warren de la Rue showed some beautiful experiments upon stratification, with 1000 cells of his chloride of silver battery and condensers. There were many other non-electrical displays of great beauty, one of the most attractive being an instrument exhibited by Mr. Crookes, F.R.S., and called the radiometer, which revolves under the influence of radiation; the rapidity of revolution being in proportion to the intensity of the incident rays.

Correspondence.

ELECTRICAL PUZZLES.

To the Editor of the Telegraphic Journal.

Sir,—Before the introduction of systematic testing of lines into India, a vexatious and long interruption to communication was caused by a fault in one or more joints, the interruption only occuring during the night. After sunrise no fault was apparent, and messages were passed freely along the wire.

The wire was No. 1 B.W.G, joints zinc ingots, on the occasion to which I refer. Locality, sea-coast. We arrived at the suspected spot (my suspicion being based on the fact that, within a mile or two on either side, signals had been exchanged on the last night of the interruption; the numerous ingots in a short length, and the appearance of the wire, which was almost double its natural thickness, in consequence of a coating of what looked like common salt). I occupied myself in running out a spare piece of wire, so as to form a loop for about ¾ of a mile; by means of this loop, somewhere like thirteen joints were bridged. As night set in this loop was brought into circuit; and at midnight, on attaching my portable instrument, I was not surprised to find that communication was perfect, and no stoppage whatever had been noticed; on disconnecting the loop an immediate stoppage ensued to through communication.

The piece of wire looped out was next day removed to the nearest telegraph office (the new piece being permanently placed in circuit). On arrival at the stations, signals could barely be passed through two, and not *at all* through a third joint, either during the day or night.

I intend shortly to read a paper on the above, giving all particulars, but in the meantime would be glad to know the opinion of some of the leading electricians who peruse your journal.—I am, &c., MORSE.

March 19, 1875.

P.S.—I might add, to increase the difficulty in solving the cause, that the days were hot and dry during the time communication was perfect. Nights chilly; in with dew, while the interruption continued. As far as I remember, these nocturnal stoppages extended over a period of three weeks.

ENQUIRY.

To the Editor of the Telegraphic Journal.

SIR,—I once read that, if a diamond be laid on a needle, the loadstone would not attract it. Has anyone verified this statement?

INQUIRER.

Electrical Science in English and Foreign Journals.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Vol. lxxx., No. 9. March 1, 1875.

Experiments on the Artificial Imitation of Magnetopolar Native Platinum.—M. Daubrée.—It is known that certain samples of native platinum not only act on the magnetised needle, but are even magnetopolar, similar to true magnets. Berzélius, in a paper on the composition of platinum minerals, noted this property in some nuggets from Nischne-Tagilsk (Oural), which he submitted to analysis.* The auriferous sands of Oural, after repeated washings, leave a residuum in which the gold is mixed with a ferruginous substance. To extract this substance a native magnetic oxide of iron magnet was used, and after this would not act, a magnet of native platinum was able to fetch away a still further quantity of iron particles. Such was the experiment undertaken by Kokscharow, in 1866, from which he concluded that natural platinum magnets are much stronger than natural oxide of iron magnets. Sundry analyses have shown that grains of platinum endowed with magnetism are always alloyed with a certain inconsiderable quantity of iron. Under or over a particular quantity the platinum, although magnetic, *i.e.*, capable of being attracted by the action of a magnet, is not itself magnetopolar. Now we know that magnetic mineral substances may, as a result of different operations, become magnetopolar; and Edward Becquerel has shown that platinum, with traces of iron, under the action of energetic poles, may acquire likewise the magnetic property. The examples in which magnetopolar platinum magnets (containing some traces of iron) were successful, is attributed by the author to the influence of the terrestrial globe. To ascertain whether such was the case, some platinum was melted with a small quantity of iron into the form of a bar, the mould, being carefully laid in the plain of the magnetic meridian during the melting and until quite cold. Two very energetic poles were then found at its extremities, placed exactly like those of an ordinary magnetised needle; this was not a chance result. This goes to confirm the importance the globe's general action may have had in the distribution of the different poles of various magnetic minerals and rocks, at the moment when those minerals and rocks were first formed.

On Magnetism.—Count du Moncel.—A series of experiments, somewhat similar to those undertaken by M. Jamin (see abstract of M. Jamin's article on the "Depth and Superposition of Magnetism," in *Comptes Rendus*, No. 7) were carried out by the Count as far back as the year 1862. He had a solid core, and a hollow one, made of exactly equal length and diameter; a solid cylinder was also prepared of such dimensions as to fill up the internal space of the hollow core. The length of the cores was 7 c.m.; diameter 14 m.m.; thickness of the hollow tube 2 m.m. The magnetising coil was wound with No. 16 wire (4-10ths of a m.m. in diameter) 2800 turns, having a length of 228 metres. Twenty of Daniell's elements constituted the battery. At an attractive distance of 1 m.m. the results were:

With hollow core	25 grms.
With solid core	38 „
With hollow core, containing the solid cylinder	37 „

Having previously observed that extent of polar surfaces played an important part in magnetic attractions, the Count cut off from the end of the solid cylinder a slice 5 m.m. thick, which he fastened to the end of the hollow core by means of a copper pin. The attracting force was also thus increased from 25 grms. to 37 grms., and introduction into the hollow core of the remainder of the solid cylinder (now 6·5 c.m. long) made no difference. Moreover, on taking away the 5 m.m. slice, and leaving the 6·5 c.m. cylinder in its old position, so as to be 5 m.m. distant from the armature, the attractive force fell to 25 grms. This showed beyond doubt that, "in these experiments, as regards the magnetic force developed, *the interior mass of the magnetic core was quite useless excepting in the vicinity of the polar extremity exciting the attraction.*" Continuing the experiments by enveloping the extremity of the hollow core with an iron ring, it was found that, instead of the magnetisation being increased, it fell slightly below 25 grms; and the introduction of the iron 5 m.m. slice failed to restore it to the same power as that of the solid core. From the following formula may be deduced the thickness required by tubular electro-magnetic cores to render them most efficient:

$$c' = c \sqrt[3]{\frac{x^2}{4(x - 1}}$$

here c' = diameter of the hollow core; c that of the solid core, susceptible of being magnetised to saturation under the influence of the current employed, x, the divisor of c', to represent the thickness of the tube which thus becomes a function of the diameter. This value of x may be made as much as 7 without great inconvenience. M. Hughes made it 4 for telegraphic electro-magnets of 1 c.m. diameter.

Annalen der Physik und Chemie, von J. C. Poggendorff. 1875. No. 2.

On the Galvanic Conductivity of Fused Salts.—F. Braun.

Combination of Facts which prove a Decrease of Volume in Consequence of Chemical Transformation in Solid Bodies.—W. Müller.

Electric Conductivity of the Chlorides of the Alkalies and Alkaline Earths, and of Nitric Acid in Aqueous Solutions.—F. Kohlrausch and O. Grotian.

On the Theory of the Galvanometer.—H. Weber.

Reply to Some Remarks, by Baron R. V. Eötvos.—E. Ketteler.

Remarks on Helmholtz's Theory of Vowels.—E. V. Quanten.

A Reply.—R. Schneider.

On the Choice of the Section of Lightning Conductors.—W. A. Nippold.

Remarks on Edlund's Essay on the Nature of Electricity.—G. Baumgartner.

Description of a Very Simple Apparatus for Photographing the Spectrum.—H. W. Vogel.

On the Visible Phenomenon of Interference in Case of Dusty and Unclean Mirrors.—M. Sekulié.

---

* A magnetopolar nugget is in the possession of the Duke Nicolas, of Leuchtenberg, and weighs 3·833 kilogrammes.

Experiments on Apparent Adhesion.—J. Stefan.

On the Conductivity of the Haloid Compounds of Lead.—E. Wiedemann.

Lymington Literary Institution.—On Tuesday evening, March 16th, a most interesting lecture on "Submarine Telegraphy," was delivered before the members of the Literary institution, by J. Sivewright, Esq., superintendent of postal telegraphs. The chair was taken by the Rev. E. P. Williams-Freeman, M.A., one of the vice-presidents of the institute. The lecture hall was crowded on the occasion, many of the neighbouring gentry being present. The lecture, which was accompanied with many highly interesting and practical illustrations, was listened to with deep attention and interest to its close. The lecturer had last year given a great intellectual treat to the members of the institution, and it scarcely need be said that the high anticipations formed of his second appearance were more than realised. Mr. Sivewright has not only the thorough mastery of his subject, but also the art of making people understand him—being clear, graphic, and not without considerable humour. Mr. Sivewright gave an interesting sketch of telegraphy from its commencement till its application to marine communication, and the laying down of the last Atlantic cable. Specimens of telegraphic cables were exhibited in abundance, and their various defects and excellencies ably pointed out. The progress of submarine telegraphy was ably pourtrayed, and the lecturer showed convincingly that before long the imagination of the poet, "to put a girdle round the earth in forty minutes" will be cast into the shade by the realities of the electric telegraph. As late as 1873 Great Britain was connected with Europe by twelve cables, and with Ireland by five. From Europe to America four cables cross the Atlantic, three from Ireland and one from France, and projects are on foot for the construction of other cables, one to join South America with Lisbon. A cable from Nagasaki to Shanghai now joins the internal system of Japan with the outer world; while, by the submersion of cables from Singapore to Batavia (557 miles), also of another of 1082 miles from Banjoerangie (Java) to Fort Darwin, North Australia, the distant colonies are brought into the telegraph system of the world. The cables laid in the earlier stages of the art have passed through many vicissitudes, and have entailed much loss through imperfect construction, mishaps in laying, failure of insulation, &c. But it is now well understood that, with careful testing and supervision, and with the weight of cable duly proportioned to the strain, &c., a cable forms a permanent property of much value. The maxim is laid down that "there is no decay inherent in the nature of a cable; all deterioration is external."—*Lymington Chronicle.*

Post-Office Telegraphs.—Statement showing the total number of messages forwarded from Postal Telegraph Stations in the United Kingdom during the week ended the 3rd April, 1875, and during the corresponding week of 1874:—1875, 375,821; 1874, 314,773; increase in the week of 1875 on that of 1874, 61,048.—Week ended 10th April, 1875, and corresponding week of 1874:—1875, 400,383; 1874, 342,229; increase in the week of 1875 on that of 1874, 58,154.

The traffic receipts of the Brazilian Submarine Telegraph Company for the three months ending 31st March last, amounted to £34,217.

The report of the Cuba Submarine Telegraph Company just issued states that the revenue account shows a net balance of £6464 17s. 4d., from which, after deducting the debit balance brought from the preceding half-year's account, there remains sufficient to pay the accrued dividend on the Ten per Cent Preference Shares, and leave £1845 0s. 11d. to be carried to the credit of the reserve fund.

Anglo-American Telegraph Company.—The ordinary half-yearly meeting of the proprietors was held on the 9th instant, at the City Terminus Hotel, Viscount Monck in the chair. The noble Chairman, in moving the adoption of the report, said that the efficiency of the work of management had been blended with economy, and he was pleased to say that replies had been received from New York to messages sent from London within the business hours of the day, which, allowing for the difference of time, would only allow one hour for transmission and reply. The average time of sending a message to New York was only ten minutes. The financial position of the company seemed to cause dissatisfaction amongst a number of shareholders. On the 1st of May next, the Anglo-American Company had determined to reduce the tariff to 2s. per word, and he urged upon the meeting not to sanction the publication of accounts or receipts, except at the time of the half-yearly meeting. Captain Hamilton seconded the motion. Mr. John Wilson moved, as an amendment, that the receipts be published monthly. Mr. Dalby seconded the amendment. Several shareholders supported the amendment. When the amendment was put to the meeting it was declared carried on a show of hands. A poll was demanded, the noble chairman announcing that the board held a majority of votes by proxy. The poll was then proceeded with. After a scrutiny of the votes the result of the poll was declared to be:—For the amendment: personal votes, 60; amount of stock, £178,776; number of votes upon that stock, 3955; there were no proxies for the amendment. Against the amendment: personal votes, 25; amount of stock, £58,588; number of votes, 1166; by proxies, 2052 persons; amount of stock, £1,640,000 with 34,018 votes. The majority in favour of the chairman's proposition was therefore declared to be 30,063. The meeting, which lasted nearly five hours, then terminated.

The traffic receipts of the Direct Spanish Telegraph Company (Limited) for the month of March, 1875, were £1475, against £1104 in February.

The receipts of the Submarine Telegraph Company for the month of March amounted to £9289, against £9561 for the corresponding month of last year.

Our Exchange.

All letters must be addressed to the publisher. The column is *free* to subscribers. Non-subscribers pay 6d. for each entry of twelve words, and 1d. for each additional two words. Price in figures counts as one word. Applications, accompanied with stamps and names and addresses, must be sent to the publisher. It is preferred that communication should, as much as possible, be maintained between seller and buyer.

The column is intended to be the vehicle of the expression of wants in books and apparatus, and of a means to supply those wants.

FOLLOWING SURPLUS APPARATUS FOR SALE,
In Good Order:—

Electro-magnet, adjustable coils, 10 lbs. of wire, only 42s.—Thermo-electric pile, bismuth and antimony, 25 pairs, well finished, only 40s.—Bichromate batteries, 10s. per cell, cost 15s.—Small voltameter, gold-leaf electroscope, a few vacuum tubes, and other items, can be had for a few shillings each.—Eden, Government Telegraphs, Edinburgh.

To Correspondents.

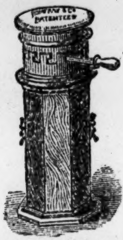
Mr. Edwards is at perfect liberty to do as he requests, and we wish his venture every success.

HOMFRAY & COMPANY,

7, GREAT WINCHESTER STREET BUILDINGS, LONDON, E.C.

PATENTEES AND PROPRIETORS OF PATENTS FOR

IMPROVED PNEUMATIC AND MECHANICAL STEERING AND ENGINE ROOM TELEGRAPHS FOR SHIPS.



Communicator.

Indicator.

Order House or Cabin Indicator with Bell.

Call Bell.

Also for Ships' Cabins, Houses, Warehouses, Docks, Mines, Coal-Pits, Railways, &c.

FOR SHIPS, PNEUMATIC TELEGRAPHS FOR LONG DISTANCES,

Simple and effective, not affected by change of temperature, therefore requiring no adjustments

FOR HOUSES, SHIPS' CABINS, OFFICES, &c., &c.

PNEUMATIC SIGNALS AND BELLS,

Far superior to the Electric—no defective insulation—no maintenance of batteries—so that when once fitted no further attention is required; the annoyances arising from slack and broken wires so common in the usual crank and wire system, are in this unknown.

FOR SHIPS, MECHANICAL TELEGRAPHS, PATENT.

We beg to call especial attention to these Instruments, in the price of which we have lately effected a considerable reduction; they are the most perfect and reliable instruments yet introduced.

NOTE—Although the proprietors of patents other than our own, we beg to state that the Patentees are *in no way connected with us, or in any way interested in the sale of our manufactures;* further the material and workmanship of our instruments can be relied upon as of the very best description.

PRICE LISTS AND FULL PARTICULARS AS ABOVE.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

Published on the 1st and 15th of each month. Price 4d.; Subscription, 9s. per annum post free.

Handsomely bound in cloth, gilt, Vol. I., 9s. 6d.; Vol. II., 10s. 6d.
Subscribers' Numbers bound in black cloth, gilt, 2s. Binding cases, 2s.

LONDON: HENRY GILLMAN, BOY COURT, LUDGATE HILL, E.C.

THE

Magneto Company,

LIMITED,

TELEGRAPH ENGINEERS & CONTRACTORS.

37, QUEEN STREET, E.C.

MAGNETO-ELECTRIC BELL-PULLS,
To Ring ordinary Electric Bells, without Batteries.

MAGNETO-ELECTRIC A B C INSTRUMENTS,
Price £6 10s. To work without Batteries

MAGNETO-ELECTRIC TYPE-PRINTING INSTRUMENTS,
Price £16. To work without Batteries.

MAGNETO-ELECTRIC MORSE INSTRUMENTS,
Best finish. To work without Batteries.

MAGNETO-ELECTRIC COMMUNICATORS FOR MINES,
To work without Batteries.

MAGNETO-ELECTRIC FUZE EXPLODERS,
Best ever introduced.

MAGNETO-ELECTRIC BLOCK INSTRUMENTS,
To work without Batteries.

BATTERIES—BENNETT'S PATENT,
The Cheapest and Best.

ELECTRIC BELLS, and every description of ELECTRIC APPARATUS manufactured.

Trade supplied. Price Lists on application.

ELECTRICAL ENGINEERS.

WHOLESALE, RETAIL, & EXPORT
Philosophical Instrument Makers.

Send for Catalogue, gratis and post free

STORY & CO.,

20, HIGH HOLBORN.

Batteries, &c., of every description cheaper than any house in the trade.

Estimates given for fixing Bells in Houses, &c., complete.

Why fix the old-fashioned Bells, when Electric Bells are cheaper, neater, and less liable to get out of order.

Our Batteries only require attention every 18 months.

BOHLKEN'S IMPROVED PATENT EARTH BORERS

Are indispensable Tools for

BORING HOLES FOR TELEGRAPH POSTS,
Fences, Scaffolds, Trees, Tube Wells, &c., &c.

PRICES:

3	4.	5.	6.	7.	8.	9.	10.	12.	15.	18in. diam.
9/	11/6	13/6	15/-	15/6	17/-	18/-	20/-	26/-	31/-	36/- each.

Each Borer is provided with 4 ft. Bar and Handle.

May be had through any ironmonger, or direct from the Sole Licensees,

M. SELIG, JUNIOR, & COMPANY,
108, QUEEN VICTORIA ST., LONDON E.C

TO TELEGRAPH ENGINEERS AND INSTRUMENT MANUFACTURERS.

WALTER HALL,

TELEGRAPH CONTRACTOR AND MANUFACTURER

EVERY DESCRIPTION OF TELEGRAPHIC APPARATUS.

Silk and Cotton-Covered Copper Wires suitable for every kind of Electrical Instruments.
German Silver Wires for Resistance Coils.
Coils for Electric Bells. Needle and other Instruments Wound and Tested to order.
India-Rubber, Gutta.Percha, and other kinds of Insulated Wire, requisite in fitting-up Electric Bells for domestic and other purposes.
Telegraph Cables for Submarine, Subterranean Aërial Telegraphs, Mines and Gunnery Experiments; also for Naval and Engineering purposes.

Ebonite, Tissue Gutta-Percha, Paraffin. India-Rubber and Shell-Lac Varnishes, &c., supplied.

WORKS—MANSFIELD STREET, SOUTHWARK, S.E.
CITY OFFICES AND WAREHOUSES—21, ALDERMANBURY, E.C.

HORATIO YEATES,

PHILOSOPHICAL INSTRUMENT MAKER,

HAS REMOVED TO

33, KING STREET, COVENT GARDEN,
LONDON, W.C.

INDUCTION AND MEDICAL COILS, BATTERIES, GALVANOMETERS, PLATINUM, CARBON, AND ZINC PLATES, COVERED WIRE, &c., &c.

EXPERIMENTAL WORK EXECUTED BY EXPERIENCED HANDS.

JOSEPH GILLOTT'S
STEEL PENS.

Sold by all Dealers throughout the World.

THE
TELEGRAPHIC JOURNAL
AND
ELECTRICAL REVIEW.

Published on the 1st and 15th of each month.
Price 4d. Subscription 9s. per annum, post free.

SCALE OF CHARGES FOR ADVERTISEMENTS.

	£	s.	d.		£	s.	d.
Seven lines (50 words) or less, in column ..	0	3	6	Whole column or ½ page	1	10	0
Each additional line ..	0	0	6	Whole page	3	0	0
¼ column or ⅛th page ..	0	7	6	Outside page (when at liberty	4	0	0
½ column or ¼ page ..	0	15	0				

Contracts made for Repeated Insertions.

London: HENRY GILLMAN, Boy Court,
Ludgate Hill, E.C.

THE CHEMICAL NEWS.

Edited by WILLIAM CROOKES, F.R.S., &c.

Every Friday, Price 4d. Annual Subscription, £1.

In addition to articles on Scientific and Applied Chemistry, and the various branches of Physical Science, this Journal contains an encyclopædic list of chemical papers published abroad during the previous week, with abstracts of all susceptible of advantageous abridgment, thus making the two half-yearly volumes, with their copious indices, equivalent to an English edition of the "Jahresberichte."

LONDON: BOY COURT, LUDGATE HILL, E.C.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c.

Now ready, No. XLVI., *April*, 1875, price 5s.

CONTENTS.

I. Niagara. Glacial and Post-Glacial Phenomena. By Thomas Belt, F.G.S. (Illustrated.)
II. Heredity.
III. The Late Transit of Venus. By R. A. Proctor, F.R.A.S., (Illustrated.)
IV. The Question of Organic Evolution.
V. Selenography; its Past, Present, and Future. By E. Neison F.R.A.S., &c.
VI. Modern Entomology.
VII. Aërial Locomotion—Pettigrew *versus* Marey.
Correspondence, Notices of Scientific Works, Progress of the Various Sciences, &c., &c.

London: 3, Horse-Shoe Court Ludgate Hill, E.C

NEW MODEL "MORSE SOUNDER" TELEGRAPH APPARATUS,

For AMATEURS,
STUDENTS,
and PRIVATE LINES.

This Instrument, is well constructed and finished, and gives a clear, loud sound. It is capable of working on a line from 100 yards to several miles in length.

Two Sets of Instruments, with Batteries, Chemicals, Connecting Wires, and Instruction Book, in box complete, 50s.

Additional Cells, where Extra Battery Power is required, 4s. 6d. each.

Bobbins of Wire—25 yards, 3s.; 50 yards, 5s.; 100 yards and upwards, 1d. per yard.

ORDERS SHOULD BE ACCOMPANIED WITH REMITTANCE.

"It is understood to be the desire of the Post Office authorities to extend the use of the 'Morse Sounder' in this country as rapidly as possible."—TIMES, October 5.

"The Postal Telegraph Departmemt is rapidly extending the use of 'Sounders,' by converting all the inking circuits to 'Sounders'."—TELEGRAPHIC JOURNAL, November 15.

WESSMANN'S

"Pocket" Telegraph, or "Snapper" Sounder,

Price, with full Instructions, 1s., free by Post 1s. 1d.

ALABASTER & CO.,

COMMISSION MERCHANTS,

Importers and Exporters of Scientific Apparatus and Books,

57, LUDGATE HILL, LONDON, E.C.

M. SADLER,

Inventor of the

UPRIGHT MAGNETIC MACHINE,

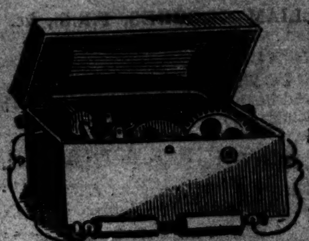
So universally used by the Medical Profession.

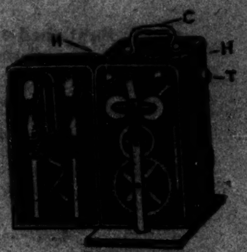
Manufacturer of

Electrical, Galvanic, Magnetic, Chemical, Photographic, and Pneumatic Apparatus.

Electric Bells and Indicators of every Description For Hotels, Warehouses, Manufactories, Mines and domestic and general use.

19 ASTON STREET BIRMINGHAM.





THE MAGNETICON

PATENTED.

Magnetic Belts, Lung Invigorators, Chest Protectors, Throat Protectors, Spine Bands, Knee Caps, Wristlets, Anklets, Friction Gloves, &c., &c., for

RHEUMATISM
NEURALGIA
GOUT
LUMBAGO
SCIATICA
DIARRHŒA
DROPSY
CROUP
SPINAL WEAKNESS
CHEST AFFECTIONS
INDIGESTION
CONSTIPATION
GENERAL DEBILITY
LOSS OF VOICE
ASTHMA
SPRAINS
EPILEPSY
BILIOUSNESS
NERVOUSNESS
PARALYSIS
LIVER AND KIDNEY AFFECTIONS
BRONCHITIS
TUMOURS, &c., &c.

Prices, 3s. to 50s. each.

The Appliances, which are made up of light comfortable materials, such as flannel, silk, merino, and velvet, are powerfully Magnetic, and supply gentle and continuous currents of ELECTRICITY without the aid of batteries, chains, or acids. They are worn over the underclothing, require no preparation, give no shocks, and generate no sores. Little or no sensation is experienced, unless it be the glow of returning health, and experience has proved that the Appliances may be worn with much benefit and perfect safety by Infants, or the most delicate Invalids.

Those whose names and addresses are appended have kindly given us permission to publish the same, as a guarantee of the genuineness of "The Magneticon." Their reasons for testifying to the great curative properties of our Magnetic Appliances are derived either from their own experience, or from their knowledge of the benefit which others have received:—

The Dowager Lady Palmer, Dorney House, Windsor.
The Rev. R. A. Knox, M.A., Rector of Shobrooke, Devon.
C. R. Woodford, Esq., M.D., Marlborough House, Ventnor.
Charles Lowder, Esq., M.D., Ryde.
Thomas J. Cottle, Esq., M.R.C.S., and L.S.A., Cheltenham.
The Rev. A. Morton Brown, LL.D., Minister of the Congregational Church, Cheltenham.
Lieut.-Col. C. W. Hodson, 25, Priory Street, Cheltenham.
Henry Hopkins, Esq., Ph.D., M.A., F.C.P., formerly Principal of Summer Hill School, Birmingham, and author of several Educational works.
The Rev. R. Williamson, The Manse, Waltham Abbey.
Mr. C. S. M. Lockhart, M.B.A.A., author of the Centenary Memorial of Sir Walter Scott.
The Rev. J. B. Talbot, Secretary and Founder of "The Princess Louise Home," Woodhouse, Wanstead.
Arthur S. Medwin, Esq., 28, George Street, Euston Square, London.
W. Johnson, Esq., Royal Hotel, Ventnor, Isle of Wight.
Mr. Maunder, Station Master, London and South Western Railway, Yeovil.
Mr. W. J. Harmer, Editor, "Stratford Courier."
Mrs. Boden, "Princess Louise Home," Woodhouse, Wanstead.
Mrs. Giniver, Kingsdown Orphan Home, 12, Kingsdown Road, Upper Holloway, London.
Mr J. Dowding Sansom, 28, New Broad Street, London, E.C.
Mr. Richard Chalice, The Dispensary, Exeter.

⁂ For additional Names, see Pamphlet.

WETTON & CO.,
Sole Manufacturer's of Wetton's PATENT MAGNETICON,
9, UPPER BAKER STREET, PORTMAN SQUARE, LONDON.
(NEAR THE METROPOLITAN RAILWAY STATION.)

A 48-page Illustrated Pamphlet, containing numerous Testimonials; a Lecture on Magnetism and Health, by Professor Hagarty, and full particulars of "The Magneticon," may be had on application, or will be forwarded post free.

A copy of "The Magnetic Review: a Record of Curative Electric Science and Journal of Health," published by Wetton and Co., will also be forwarded post free.

THE

TELEGRAPHIC JOURNAL ALMANACK

FOR 1875,

WITH MAP OF THE WORLD, SHOWING THE CABLES ALREADY LAID AND THOSE IN COURSE OF CONSTRUCTION.

Unmounted Copies, 8d. Mounted, and folded, 2s., post free.
Mounted on Rollers and Varnished, 2s.; carriage extra.

This Almanack contains information respecting the Submarine Companies, the Post Office Telegraphs, Telegraphs of the Railway Companies, Tables, Notes, &c., for Construction, Repair, and Testing of Lines, &c.

"The Publisher of the 'Telegraphic Journal' has prepared for 1875 a sheet almanack with a large quantity of information respecting telegraph lines all over the world. The matter is rendered all the clearer by a chart, on a good scale, which shows distinctly every place between which there exists electric communication."—*Standard.*

LONDON: HENRY GILLMAN, BOY COURT, LUDGATE HILL, E.C.